XLIX.—*Wasps and their Habits.* By Frederick Smith, of the British Museum, V.P. Ent. Soc., &c.

The title of this communication is also that of a very able and interesting paper by Mr. Benjamin D. Walsh, published in the 'American Entomologist' for March 1869. This paper contains a vast amount of information relative to the economy of a variety of species of insects, some belonging to the Vespidæ proper, others to the fossorial group, popularly called Sand-Wasps. Several of the histories will be new to English entomologists, others will prove highly interesting and confirmatory of accounts given by previous observers.

I purpose to make a few observations on the different species and their histories, in the order in which they follow in Mr. Walsh's paper.

Sixteen years ago I published a short paper on the economy of *Agenia punctum*, in which I expressed an opinion that none of the sand-wasps are parasitic; and subsequent observation has not led me to adopt a contrary one*. Mr. Walsh is of opinion that one genus, *Ceropales*, consisting of numerous species, is parasitic, and he assumes to have proved his case.

I offer my remarks in no captious spirit, but simply as an expression of opinion upon this subject, as well as upon some others contained in the paper, for the sole purpose of arriving at the true facts of the case, and also for the purpose of doing justice to previous observers, who have in more instances than one preceded Mr. Walsh, who is not acquainted with the works in which they made their discoveries known.

The first opinion from which I dissent is contained in the following quotation:—"Some authors have supposed that certain species of digger wasps open their nests from time to time, to furnish their young larvæ with fresh supplies of appropriate food. Strictly speaking, the digger wasps do not feed their larvæ at all: they collect suitable food in a suitable nest, lay an egg therein, close up the nest, and then leave it for ever." In my work on the Fossorial Hymenoptera I have stated that I have frequently reared *Mellinus arvensis* from the larval state: this insect provisions her nest with Diptera; and I have obtained from burrows, in a hard sand-bank, cells containing the requisite number of flies, usually four, sometimes five, according to the size of the species of flies selected (for the insect selects Muscidæ as well as Syrphidæ); and I have found the egg attached to one of the flies, deposited at the end of the cell. I have also obtained cells containing only two flies; but in such a case the egg was attached to one

* In this remark I do not include the Scoliadæ.

of them; and I have found also an egg attached to a single fly, that being all that was stored up. These insects appear in the autumn, when they can usually store up the required amount of food without interruption; but they must occasionally be hindered in their work by rainy weather; and as the egg hatches usually in five or six days, it must occasionally happen that the store has to be completed at a time when the larva is feeding on the first fly or flies that were deposited. I do not advance this as an instance in which a solitary sand-wasp feeds its larvæ periodically, but as one in which the species deviates from the general rule that obtains: the fossorial tribe of insects usually lay up the requisite store of food before they deposit an egg upon it.

The habits of a species of the genus *Sphex* (being one not found in this country, but comprising some of the largest and handsomest hymenopterous insects) are very interesting. The economy detailed is that of *Sphex ichneumonia*: this insect burrows into gravelly banks and hard pathways, and stores up a single grasshopper to nourish its future offspring: this is an additional instance recorded that shows the great diversity that frequently occurs in the economy of species belonging to the same genus. Mr. Gosse has most graphically described, in his 'Sojourn in Jamaica,' published in 1851, the economy of a large species of *Sphex* that stores up the caterpillar of a moth.

In my published notes on the economy of the genus *Cerceris* I have recorded the fact of my having captured *C. interrupta* storing up the little beetle *Apion rufirostre*; and *C. arenaria* is well known to prey upon various species of Curculionidæ: I have at one time observed *C. labiata* conveying Curculionidæ to its cells, and at another selecting *Haltica tabida*. *C. ornata*, differing more widely in its choice of provision, selects species of the short-tongued bees, *Halictus rubicundus* or *H. cylindricus* being usually its prey.

The same species of Fossor does not, therefore, at all times select the same kind of prey: thus Shuckard records the fact of *Ammophila viatica* storing up spiders; the same habit has been observed by the Rev. A. Matthews. I have several times observed the same species of *Sphex* conveying a Lepidopterous larva, but never detected it with a spider.

Another instance of variation in the selection of food may be adduced: *Tachytes pompiliformis*, a most abundant British insect in most sandy situations, frequently stores up a sandy-coloured Lepidopterous caterpillar, but as frequently may be observed preying upon the pupæ of grasshoppers.

Mr. Walsh gives interesting histories of some genera with

whose habits we were not previously acquainted. *Stizus grandis*, we learn, provisions its nest with *Cicada septemdecem*; *Pepsis formosa* preys upon *Mygale Hentzii*, and *Chlorion cæruleum* upon spiders.

A great mystery presents itself to Mr. Walsh: one or two suggestions relative to its solution are thrown out, but no opinion expressed. The insects included in the genus *Pelopœus*, popularly known by the name of "mud-daubers," have the femora and tibiæ almost destitute of spines or bristles; still some species (*P. lunatus* being an instance) have a few on the tibiæ, principally on the underside of the anterior pair: they are not, as Mr. Walsh remarks, so bristly as in the genera *Sphex* and *Ammophila*, both burrowers in the earth; but why should they be so when the bristles are of no manner of use to her, any more than they would be to a true wasp? One school of philosophers, Mr. Walsh observes, "will reply that its legs are bristly because, ages and ages ago, in the dim far-away vista of bygone geological years, the genus took its gradual origin from some species that did really dig holes in the ground, and had bristly legs to do so—and that, in consequence of the disuse of its bristles for generation after generation, through myriads of geological ages, the bristles themselves have gradually become shorter, weaker, and less numerous."

I would draw attention to one or two circumstances. I first observe that *Pelopœus* is just as destitute of spines as we find many other insects that are either known to be external builders, or that construct their mud cells in ready-made burrows or in some convenient hole or fissure adapted to their requirements: such insects belong to the genera *Agenia*, *Pemphredon*, *Pison*, and some others.

But I shall perhaps add still further to the mystery when I refer to the habits of one of the commonest species of our sand-wasps, *Mellinus arvensis*, which is quite as destitute of bristles on the legs as any species of *Pelopœus*, and yet is a true burrowing sand-wasp. There are hosts of insects with spiny legs that never burrow into any kind of substance—Diptera, for instance; many species of blowflies are examples. Spines are of use for other purposes than digging; bees comb and clean themselves with their spiny tibiæ and tarsi, as well as free themselves from the thin pellicle in which they are enveloped in the pupa state. I have witnessed the operation of escaping from the shroud that envelops the pupa of *Ammophila sabulosa*; and here the use of the bristles becomes very apparent.

Mr. Walsh is not aware that what he considers to be his

most important discovery was observed by myself and published sixteen years ago. Among the Pompilidæ there is a section that have the anterior tarsi simple (that is, without cilia) and their intermediate and posterior tibiæ without spines: such is the character of the division named *Agenia*; but when we examine a large number of exotic species, we find that, although we call them smooth-legged, some species have a few bristles on their tibiæ—though in such cases they are rudimentary or extremely fine. These insects are mud-daubers, constructing cells after the same fashion as the *Pelopœi*. Mr. Walsh finds their cells usually under the loose bark of trees. The species whose history I published had constructed its cells on the top of a bee-hive that was covered with an old cloth and a pan; from these I bred both sexes of *Agenia punctum*.

Such is the habit of *Agenia*, a builder of mud cells, and we are led by Mr. Walsh to infer that such is the habit of the entire genus, his conclusions being, of course, drawn from the fact of the species being destitute of armature on the legs; such generalizations, however, will be found to have exceptional cases: I have observed one myself.

In the north of England, *Agenia variegata* is not an uncommon species; and in the summer of 1852 I observed several females burrowing in a bank of light earth: I also once took a pair running on a bank at Coomb Wood, in Surrey; and I am inclined to believe this to be the constant habit of that species.

I have noticed the fact that some species of sand-wasps have never been observed to burrow, but avail themselves of some ready-formed burrow or hole suitable to their requirements; as instances of this habit, I may refer to *Trypoxylon fugax*, a Brazilian species that was found to have used empty cells in a nest of a species of wasp (*Polistes*). *Trypoxylon* stores up spiders, as it had done in this instance, and afterwards had closed up the cells with clay.

Mr. Horne has noticed a similar habit in an Indian species of *Trypoxylon*, which took possession of clay cells constructed by a species of the genus *Pison*; this insect attaches its cells to twigs and stems of grass, and, as is the habit of *Trypoxylon*, stores up spiders. Here a question may arise as to whether in this instance the *Trypoxylon* appropriated the store as well as the cell of *Pison*; if such were the case, we should have the anomaly of an insect being at one time a provident creature and at another time a parasite: certainly until such a fact is clearly established, we cannot assume it to be the case; I know of no circumstance that would justify such a conclusion.

Mr. Walsh obtained five mud cells constructed by *Agenia bombycina*, an American species; they were "all alike, and all of them found in company under the bark of the same tree." From these five cells there hatched out, about the end of June 1864, four specimens of *Agenia* and a single male specimen of a species of *Ceropales*, a genus of Pompilidæ: on this evidence Mr. Walsh concludes the habit of parasitism to be proved; but to this I cannot assent.

I have just alluded to *Trypoxylon* being reared from the cells of *Pison*; in that instance the cells were not deserted ones, but fresh and stored with spiders. Now we know that *Trypoxylon* is not a parasite, and we are therefore justified in concluding that the insect found a cell built by *Pison*, in every way adapted to its purposes, and took possession of it. I may remark that the cells of *Pison* and those of *Trypoxylon* are precisely of the same form and mode of construction.

Mr. Horne also bred *Trypoxylon* from a series of cells constructed by a solitary wasp, a new species of the genus *Pterochilus*: these solitary wasps store their cells with caterpillars; therefore in this instance, as *Trypoxylon* stores up spiders, we are led at once to the conclusion that the latter insect took possession of the cells of the former. Such being the case, I cannot see any reason why *Ceropales* may not in the same way have taken possession of the cell of *Agenia* in the instance mentioned by Mr. Walsh.

I have remarked, in my observations on the genus *Ceropales*, in the 'Monograph of the Fossorial Hymenoptera:'—"These insects have been considered parasites on the genus *Pompilus*; their legs almost destitute of spines, and the absence of cilia on the tarsi, I am inclined to consider indicative of a peculiar economy." St. Fargeau considered them to be parasitic insects; and in the same class he placed all the Fossorial Hymenoptera whose legs are destitute of spines: this, however, was, in accordance with his theory, based entirely on structure. Subsequent observation has long ago proved his arrangement to be fallacious. Structure in some classes of animals may prove a pretty correct index to habit, but it fails to be so when applied to insects. There is no family among the whole of those which constitute the fossorial section more eminently fossorial in structure than the Scoliadæ; their legs bristle with spines: yet these insects have long ago been proved by Passerini to be parasites; and when we become acquainted with their habits, we see at once the use of such a structure even in parasitic insects. *Scolia flavifrons* has to burrow down to the cell of *Oryctes nasicornis*; and other species have been observed preying also upon

the larva of species of *Oryctes*. Now it is quite obvious that any theory based upon structure would certainly prove fallacious in the case of *Scolia*; and it must be borne in mind that, even in the operations of such well-known burrowing species as *Sphex ichneumonia* and *Ammophila sabulosa*, half the work is really performed by the use of the mandibles; all the pebbles and harder parts of the ground excavated are removed by them, thrust backwards and kicked out of the burrow by the legs. The insects frequently issue while at work, carrying pebbles in their jaws, which they fly off with and drop at a short distance.

I have thought it desirable to pen the above observations for two reasons: in the first place, I claim to have first made known the habits of *Agenia*, in connexion with remarks upon the structural peculiarities of the insects; and, secondly, I have repeatedly published an opinion that none of the Pompilidæ are parasitic insects; and I must repeat my opinion that the evidence adduced by Mr. Walsh in favour of the parasitism of the genus *Ceropales* is by no means conclusive.

BIBLIOGRAPHICAL NOTICES.

Facts and Arguments for Darwin. By Fritz Müller. With Additions by the Author. Translated from the German by W. S. Dallas, F.L.S. 8vo. London: Murray, 1869.

Just four years ago we gave, from the 'Bibliothèque Universelle,' a general notice of the contents of Dr. Fritz Müller's little work 'Für Darwin,' in which that distinguished zoologist put forward certain observations and arguments derived from his study of the Crustacea, which he regards as almost conclusively in favour of the Darwinian hypothesis. Our former account of the contents of this remarkable book went so far into details as to render any further particulars unnecessary; and we need do little more than call our readers' attention to the recent appearance of a translation of the work by Mr. W. S. Dallas, with additions by the author. It is to be hoped that this translation will make the contents of this admirable little treatise more generally known among English naturalists; for it must be confessed that the original, although highly appreciated in Germany, has made but little progress in this country. And it must be remarked that Darwinian proclivities are by no means necessary to enable the reader to benefit by its perusal. A great part of the contents consists of the records of a long series of observations on the natural history and structure of the Crustacea, and especially on the developmental history of these animals. We know of no work from which so satisfactory a general view of the phenomena is to be obtained. Indeed this is no more than might have been